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COMBINING THE CONCEPTS OF BENCHMARKING AND MATRIX GAME IN MARKETING (RE)POSITIONING OF SEAPORTS

ABSTRACT

This paper considers the effects of the combination of two different approaches in developing the seaports positioning strategy. The first one is based on comparing the most important quantitative and qualitative seaports choice criteria by the benchmarking method. Benchmarking has been used in creating the appropriate model for efficient marketing positioning of Aegean, Adriatic and Black Sea seaports. The criteria that describe the competitiveness degree of these seaports have been chosen upon the investigation of ports customers' preferences. The second employed approach based on the matrix game concept has been used for the purpose of optimal repositioning of the ports. However, nine selected ports' functions are treated in such a way that they are divided into two sets: one composed of the functions which are to be developed, and the other consisting of the functions which are expected to be suppressed in the future. According to the numerically obtained results the ports are repositioned, and corresponding explanations are given in the marketing manner. The mixture of these two concepts should contribute to the review of the state of these business systems and their images on the market, as well as to open prospective toward finding out the ways of creating and maintaining their competitive advantages.

KEY WORDS

seaport marketing, positioning strategy, quantitative and qualitative criteria analysis, matrix game, benchmarking, perceptual map

1. INTRODUCTION

During the past few decades, there has been an evident necessity for adopting marketing principles in maritime industry, especially in port business, considering the importance of their role in logistics supply chains. Globally, the ports' business policies are basically created in accordance with the modern principles of market business, as well as innovations imposed by modern technologies of maritime transport. Nevertheless, only a small number of ports worldwide have a developed marketing, as a concept, function and practice.

The port management of today is facing numerous marketing challenges, primarily regarding market research management. This process includes the collecting of information on the existing and potential customers, economic, technological, social and political development changes in trade and logistics, legislation and its implication on port business, development of competitive ports and other stakeholders, etc. All mentioned issues aim at resolving the dilemma: why a certain port is preferred to the alternative ones?

Modern marketing business aspects of port operations anticipate the finding of efficient ways for strengthening their position in the market, development of market participation maintenance and increase strategy, market segmentation and selection of target markets (segments), differentiation of the offer and positioning. In addition, marketing as a concept of seaport business, but practice as well, offers solutions for measuring the beneficiary satisfaction, especially for strategic attraction and keeping of profitable and loyal clients. In addition, it is necessary to apply more intensively a variety of all marketing strategies in the domain of port business, but also to have a wider comprehension of the importance of port service offer instruments (7P-service product, tariffs, distribution channels, integrated marketing communication, service processes, service ambient, people). Marketing approach to port management is based on the awareness of the customers' needs, while moving the focus from internal performances of port business (such as capacity) toward the market ones, such as beneficiary preferences.

In the widest context, the positioning of ports analyzed in this paper should enable a clear positioning in the mind of customers, and determine them so that customers can see the offer of a certain port compared to the competitive one [13]. The position developed is actually the place that organizations want to occupy in the mental map of the customers [14]. The strategic positioning of seaports started to be discussed from the wider economic aspects. Namely, the analysis of determining the competitive position of the port has included: analysis of port service portfolios, shift-share analysis and analysis of diversification [17]. Although the subject of seaport positioning has not been sufficiently researched in terms of marketing, some researches were aimed to find factors that would make the seaport services different and recognizable, e.g. based on efficiency, quality, reliability, etc. [31].

In literature two basic topics are related to marketing positioning of seaports: a) seaport competition and competitiveness, and b) the port choice criteria. Many methods have been used in order to define the factors of seaport competitive performance, but primarily benchmarking is standing out in the marketing positioning of the ports, as a method that is based solely on the comparison of variables, processes, and results of seaport functioning, etc. Pardali and Michalopoulos [28] applied the benchmarking method in ranking of 14 Mediterranean container ports, with special emphasis on determination of the position of average, leading and Piraeus port. Yeo, Roe, Dinwoodie [41] made comprehensive literature review of components of port competitiveness, concluding that port competitiveness is determined by port service, hinterland condition, availability, convenience, logistics cost, regional centre and connectivity. Efficiency, shipping frequency, adequate infrastructure, location, port charges, quick response to port users' needs, reputation for cargo damage, intermodal and value-added services, and information system availability are some of the port selection criteria [20, 21, 22, 34, 35, 36, 37, 38].

The quantitative method like AHP (Analytic Hierarchy Process) is very appropriate for setting the bases of seaport positioning (or their ranking), while port charge, tax, rent and cost, port operation efficiency, load/discharge efficiency, size and efficiency of container yard, hinterland economy and depth of berth are found as the most important contemporary port choice criteria [8]. In the domain of quantitative analyses, the theory of games has also been applied regarding marketing in the domain of: a) negotiations between buyers and sellers in the sales process, b) determining the strategy of competitive behaviour in the market, c) innovations, d) determining prices and competition between marketing subjects, e) development of marketing strategies, f) advertising and promotions, g) marketing channel, h) product marketing, i) company reputation in the market, etc. [19]. In this paper, certain port functions shall be an example of resolving matrix games, based on Von-Neuman min/max principle, presenting the constant sum game [4].

Descriptive studies are also important in terms of explaining the current moments in global port business. These are the topics related to port regionalization [24], terminalization of seaports [32], shipping networks and port development [9, 18] maritime supply chains and the role of ports within them [5, 6, 7, 23, 26, 39] etc.

All the mentioned methodologies confirm the extent and complexity of the related topic. The paper discusses many aspects of seaport positioning, but what makes it innovative is that particular attention is paid to the marketing dimension of the issue.

2. METHODOLOGY

In the paper, two sets of criteria have been analyzed: quantitative (7) and qualitative ones (26), which are listed in *Table 1* and *Table 2*. These two sets of criteria are divided into several subsets of criteria [3, 28, 33]. The sets of the considered container ports (P1 - Bar; P2 - Durres; P3 - Constantza; P4 - Koper; P5 - Piraeus; P6 - Ploče; P7 - Rijeka; P8 - Thessaloniki) have been subjected to the following methodology in order to make their proper positioning:

- The quantitative and qualitative sets of criteria have been identified;
- Two focus groups have been formed. The experts and researchers formed the first one, while the customers formed the second one. The respondents were asked (in the form of an interview) to estimate the importance of each criterion, from their own point of view, on the scale from 1 to 10;
- The focus group members' i.e. responders' grades are collected and the average values per each of the predefined criteria have been calculated for each of the analyzed ports;
- These average values of grades are used later as weight coefficients or ponders by which the values representing the considered criteria are multiplied;
- The scores obtained by the previous calculus are summed per each of eight considered ports; and
- The obtained scores for quantitative and qualitative criteria, as well as the total score, have been used for positioning the examined ports, which is shown by the perceptual maps. The mathematical formulation that follows the previous linguistic statements is given below.

Table 1 - Quantitative criteria (A)

A. Quantitative criteria	A1. Container terminal infrastructure features	C_A1.1	Number of berths (no.)
		C_A1.2	Total length of berths (m)
		C_A1.3	Maximum water depth (m)
		C_A1.4	Terminal storage capacity (TEU)
		C_A1.5	Gantry crane (no.)
	A2. Cargo handling and human capacities	C_A2.1	Total cargo handling turnover (tons)
		C_A2.2	Daily operations (hours)

Firstly, it is to be noted that each of the analyzed criteria has been assigned the appropriate variable: v_{A_i} - for quantitative criteria ($i = \overline{1,7}$), and v_{B_j} - for qualitative criteria ($j = \overline{1,26}$). Values of v_{A_i} are in fact exact numerical values corresponding to each quantitative criterion per each of the considered ports (Appendix, Table A.1). Values of v_{B_j} are binary ones (Appendix, Table A.2). Namely, if the considered port has the qualitative criterion (feature) v_{B_j} has the value one (1), and vice versa, the variable has the value zero (0) [28].

The values of the quantitative criteria are divided with the maximum value among them, per each of the considered ports, in order to neglect the differences in numerical values. However, the variables $v_{A_i}(i = \overline{1,7})$, are now replaced by $\overline{v_{A_i}} = v_{A_i} / \max(\{v_{A_i}, i = \overline{1,7}\})$. The intention is to reduce all numerical values of the quantitative criteria to the interval between 0 and 1 $(0 \leq \overline{v_{A_i}} \leq 1)$. Further on, the respondents from the focus groups, formed of the experts (5), researchers (5), and customers (10), estimated each criteria importance according to their own opinions (on the scale from 1 to 10). Their marks have then been averaged. The average values per each criterion are used as weight coefficients w_{A_i} - per quantitative criteria ($i = \overline{1,7}$), and w_{B_j} - per qualitative criteria $(j = \overline{1,7})$. This method of estimating weight coefficients through

Table 2 - Qualitative criteria (B)

B. Qualitative criteria	B1. Infra and superstructure features	C_B1.1	General cargo terminal (Y/N)
		C_B1.2	Bulk cargo terminal (Y/N)
		C_B1.3	Liquid cargo terminal (Y/N)
		C_B1.4	Ro-Ro terminal (Y/N)
		C_B1.5	Passenger terminal (Y/N)
	B2. Connections with hinterland	C_B2.1	Railway connections (Y/N)
		C_B2.2	Road connections (Y/N)
		C_B2.3	Pipeline connections (Y/N)
		C_B2.4	Barge service (Y/N)
		C_B2.5	Shuttle service (Y/N)
	B3. Marketing features	C_B3.1	Free zone (Y/N)
		C_B3.2	Value-added logistics services (Y/N)
		C_B3.3	Distribution centres (Y/N)
		C_B3.4	Quality Management System (Y/N)
		C_B3.5	Integrated marketing communications (Y/N)
	B4. Port management models	C_B4.1	Service port model (Y/N)
		C_B4.2	Tool port model (Y/N)
		C_B4.3	Landlord port model (Y/N)
		C_B4.4	Private port model (Y/N)
	B5. Vessels' and cargo services	C_B5.1	Vessel monitoring (Y/N)
		C_B5.2	Vessel repair (Y/N)
		C_B5.3	Vessel servicing (Y/N)
		C_B5.4	Container control (Y/N)
		C_B5.5	Container leasing (Y/N)
	B6. ICT applications	C_B6.1	EDI service (Y/N)
		C_B6.2	VTS service (Y/N)

interview requires highly developed logical thinking, so the estimate of only one highly qualified expert (or 20 experienced persons, as in this paper) may be more important than the estimates made by a considerably larger number of inexperienced persons [30].

However, the total benchmarking score for quantitative and qualitative criteria, per each of the considered ports can be calculated by the following formulas:

$$BA_k = \sum_{i=1}^{7} w_{A_i} \cdot \overline{v_{A_i}},\ k = \overline{1,8} \quad (1)$$

$$BB_k = \sum_{j=1}^{26} w_{B_j} \cdot v_{B_j},\ k = \overline{1,8} \quad (2)$$

where

- BA_k – is the total benchmarking score for the quantitative criteria for k-th port;
- BB_k – is the total benchmarking score for the qualitative criteria for k-th port;
- w_{A_i} – is the weight coefficient per i-th quantitative criterion from A, while i – is the number of quantitative criteria;
- $\overline{v_{A_i}}$ – is the value of the i-th criterion in A divided by the maximum numerical value of that criterion per each port;
- w_{B_j} – is the weight coefficient per j-th qualitative criterion from B, while j - is the number of qualitative criteria;
- v_{B_j} – is the binary value of j-th qualitative criterion;
- k – is the number of ports, here $k = 8$.

Since the Excel sheets are employed in realization of the calculus two SUMPRODUCT (array_1; $array_2) imbedded functions are actually used: one for quantitative (A) sub-set of criteria, and the other for qualitative (B) sub-set of criteria. In both cases array_1 corresponds to the values of the variables representing criteria, while the values of the $array_2 are fixed and represent the values of corresponding weight coefficients.

More precisely, on the basis of formulas (1) and (2), it is possible to create separate perceptual maps for both quantitative and qualitative criteria analysis per each of the ports which are to be mutually positioned on the market.

2.1 POSITIONING BASED ON THE QUANTITATIVE CRITERIA ANALYSIS

In the previous section the defined formula (1) is a general one, and it is to be modified depending on the needs for different calculi. Namely, in the case of estimating an imaginary leading port the total benchmarking score is reduced to the formula:

$$BLP_A = \sum_{i=1}^{7} w_{A_i},$$

since $\overline{v_{A_i}} = 1$, while in the case of calculating the imaginary average port total benchmarking score, the following formula can be applied:

$$BAP_A = \sum_{i=1}^{7} w_{A_i} \cdot \mathrm{AVG}(v_{A_i})/\mathrm{MAX}(v_{A_i}).$$

The obtained values of benchmarking total scores for each port (BA_k, $k = \overline{1,8}$), the imaginary leading port (BLP_A), and the imaginary average port (BAP_A), are shown in *Figure 1*.

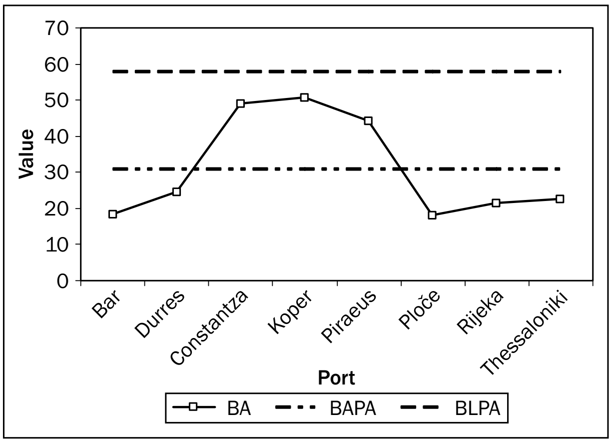

Figure 1 – Positioning of investigated seaports based on the quantitative criteria analysis

According to the scores for the imaginary leading and average ports it is possible to calculate the following differences: D_LPA - the differences between values of the benchmarking total scores for imaginary leading and each considered port; and, D_APA - the differences between values of the benchmarking total scores for imaginary average and each considered port. The obtained numerical results are given in *Table 3*.

Table 3 - The variations among leading, average, and each considered port in A

Port	D_LPA	Rank 1	D_APA	Rank 2
P1 – Bar	39.638	7	12.727	7
P2 – Durres	33.476	4	6.565	4
P3 – Constantza	8.906	2	-18.004	2
P4 – Koper	7.451	1	-19.460	1
P5 – Piraeus	13.894	3	-13.017	3
P6 – Ploče	39.804	8	12.894	8
P7 – Rijeka	36.560	6	9.650	6
P8 – Thessaloniki	35.555	5	8.645	5

Based on the numerical results given in *Table 3*, the Koper port, in terms of quantitative criteria, generally viewed, is positioned in the market as the leading port. In case the criteria are considered individually, this port has the best competitive performance in regard with: the number of berths; total length of berths; and maximum water depth. The port of Constantza achieves the highest total cargo handling turnover, while sharing the same number of gantry cranes with the leading port. Furthermore, the port of Constantza has the highest terminal storage capacity, while the third positioned port of Piraeus, based on this quantitative criterion, is superior compared to the leading port of Koper. It is important to emphasize that in terms of daily operations, all ports are well positioned, since they provide services 24 hours a day.

In creating this kind of port positions, in addition to the values of fixed quantitative parameters, the values of related weight coefficients were also included. Namely, the respondents gave approximately the highest values to the terminal storage capacity parameter, followed by the maximum water depth, noting that the differences in valuing the two parameters were minor. The port service customers treated the total length of berths and the number of gantry cranes fairly equally, awarding them very high weight values. Daily operations are given the priority compared to the number of berths, but also the total cargo handling turnover, which, to some extent, influenced the better position of the Koper port compared to the biggest Black Sea port of Constantza.

2.2 POSITIONING BASED ON THE QUALITATIVE CRITERIA ANALYSIS

The situation with qualitative criteria is simpler compared to the previously described one. For the purpose of estimating an imaginary leading port the total benchmarking score BB_k $(k=\overline{1,8})$ is reduced to the formula:

$$BLP_B=\sum_{j=1}^{26} w_{B_j},$$

since $v_{B_j}=1$. In the case of calculating the imaginary average port total benchmarking score, the following formula can be applied:

$$BAP_B=\sum_{j=1}^{26} w_{B_j}\cdot AVG(v_{B_j}).$$

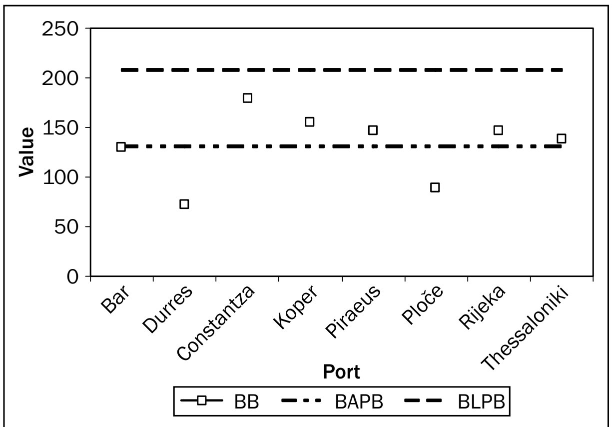

Figure 2 – Positioning of investigated seaports based on the qualitative criteria analysis

The obtained values of benchmarking total scores for each port (BB_k, $k=\overline{1,8}$), the imaginary leading port (BLP_B), and the imaginary average port (BAP_B), are shown in *Figure 2*.

Based on the scores for imaginary leading and average ports it is possible to calculate the following differences: D_LPB - the differences between the values of the benchmarking total scores for imaginary leading and each considered port; and, D_APB - the differences between the values of the benchmarking total scores for imaginary average and each considered port. The obtained numerical results are given in *Table 4*.

Table 4 - The variations among leading, average, and each considered port in B

Port	D_LP_B	Rank 1	D_AP_B	Rank 2
P1 – Bar	85.907	6	9.188	6
P2 – Durres	135.779	8	59.059	8
P3 – Constantza	28.607	1	-48.113	1
P4 – Koper	53.093	2	-23.627	2
P5 – Piraeus	61.071	3	-15.648	3
P6 – Ploče	118.607	7	41.888	7
P7 – Rijeka	61.150	4	-15.569	4
P8 – Thessaloniki	69.543	5	-7.177	5

In analyzing the qualitative parameters, the port of Constantza reaches the best position in conditions in which the eight examined ports share the same target market. The port of Koper has features significantly different compared to the leading one, but here it is perceived by the customers as the second-ranked. The ports of Piraeus and Rijeka are expressively competitive with each other, while the port of Thessaloniki is positioned slightly above the average. Among the weakly positioned, there are the ports of Ploče and Durres, while the Port of Bar, with appropriate management efforts, could be led to the level of an average port. When considering the ponder values, it can be concluded that, generally, the hinterland connections criteria are more highly ranked than ICT applications and marketing variables, while slightly lower ponder values are found accompanying port management models and infrastructural features.

3. MATRIX GAME IN THE REPOSITIONING OF THE SEAPORTS

In general, the theory of games is considered an examination of decision-making issues in the situations when several *players* – decision makers, participate [12]. In addition to this, the theory of games is considered a way of anticipating the results of *the game*, representing commercial situations in which two or more players participate, being mutually re-

Table 5 - Development criteria (C)

C. Development criteria	C1. Port functions preferred to be empowered	C_C1.1	Container cargo handling
		C_C1.2	Automation of processes
		C_C1.3	ICT applications
		C_C1.4	Range of port services
		C_C1.5	ISPS and accident prevention
		C_C1.6	Environmental protection and port sustainability
	C2. Port functions preferred to be suppressed	C_C2.1	General cargo handling
		C_C2.2	Number of employees
		C_C2.3	Role of the government in port managing

lated and inter-dependent [42]. The *Player* in maritime market can be any port, ship operator, shipper, agent or other that must take into consideration the actions of the other before establishing their own business strategy and during the period of its implementation. Therefore, the maritime industry has applied two game categories: non-cooperative and cooperative games [10]. According to the given classification, the cooperative approach can be applied to alliances of liner sea transport and alliance of port transport (hub-and-spoke system). Thus, Guo and Min discuss the situation in which the shipper chooses the strategy of maximizing net profit, liner shippers the strategy of minimizing the total logistics cost resulting from the total cargo transport, and port authorities appear as the player in charge of management and marketing policies in order to maximize port tariffs and taxes, but also tending to maximize their own contribution to the national economy. As the result of the numerical calculation gained from the three-party game, we get the optimal position (location) of the hub port, but also the accompanying ports in the related hub-and-spoke system. The authors emphasize that the same model of cooperative games can be applied to the optimization of transport routes at the national, regional and world level. Furthermore, the strategy of coalition games on the example of port has been examined within the port co-opetition concept [11].

In this part of the paper, the example of the well known two-player zero-sum matrix game is discussed, which needs to give an answer to the question: how will the considered ports be (re)positioned on the basis of the analysis of their development features? Consequently, the players, i.e. two groups of confronted functions are given in *Table 5* [43].

3.1 DETERMINING THE REWARD MATRIX

The top managers in the considered ports matched the analyzed development functions, in accordance to the matrix game concept, and estimated their importance on the scale from 1 to 5, according to their experience or intuitively (*Table 6*).

Table 6 - The importance of the ports' development functions

Port/ Criteria	P1	P2	P3	P4	P5	P6	P7	P8	Avg.
C_C1.1	5	4	5	5	4	3	4	5	4.375
C_C1.2	4	3	5	4	4	4	4	3	3.875
C_C1.3	4	3	5	4	4	4	4	4	4.000
C_C1.4	3	3	4	2	2	4	5	5	3.500
C_C1.5	3	4	5	4	4	4	3	3	3.750
C_C1.6	4	4	5	4	4	4	3	5	4.125
C_C2.1	3	2	3	3	4	4	2	2	2.875
C_C2.2	4	3	5	1	4	4	2	5	3.500
C_C2.3	4	4	4	2	4	4	4	3	3.625

Then, the top managers are asked to define the reward matrix for the confronted functions for their own ports. However, the profound question which is here: what logic should be used in estimating the reward matrices? The possible explanation in which way this might be done is given through the following example (*Table 7*).

Table 7 - An example of reward matrix for two confronted sets of development port functions

Confronted functions	C_C2.1	C_C2.2	C_C2.3
C_C1.1	3	3	4
C_C1.2	1	4	4
C_C1.3	-2	2	3
C_C1.4	4	-3	4
C_C1.5	1	-2	-5
C_C1.6	2	-3	-5

The pairs of corresponding strategies may be explained as follows [1, 2]:

– (C_C1.1, C_C2.1): (+3) – Along with the aim of achieving effective integrated transport, there was need for a unified manipulative transport unit - container, as result of developments in cargo handling and packaging technologies. It is clear that nearly all ports around the world are trying to increase their own level of containerization, which consequently has impact on reducing the rate of conventional general cargo handling. However, this coefficient in the reward matrix is positive and estimated as +3;

- (C_C1.1, C_C2.2): (+3) – Growth of the volume of container loading significantly affects the reduction of the number of employees in the port. For example, the unloading/loading sacks, pallets, bales, etc., need to engage more stevedores on the ship, operating queue, and warehouses. On the contrary, for the container transhipment it is not necessary to engage a stevedore on board, and the port operating queue, as logistics supporters of loading/unloading processes. The reason is that a modern container crane has a capacity which can compensate for the work of at least five workers, or more. But of course, although it has a tendency to development, container transport cannot be based only on mechanization and automation; it still requires live working force, and therefore this coefficient is positive, but limited to (+3);
- (C_C1.1, C_C2.3): (+4) – Due to the appearance of a large number of operators in container terminals, and their investments in port superstructure and equipment, the ownership structure of the ports is commonly changing in favour of private capital, though the role of the Government in this field of port management is becoming weaker. The container business is attractive, trying to find and attract private operators, and thus the role of the government is becoming less entrepreneurial and more regulatory. The coefficient assigned to this pair of strategies in the game has quite a high ratio of (+4), which means intensifying the growth of container transhipment at the expense of reducing the role of the government in managing the port.

Since the previously explained coefficients in the reward matrix have "+" prefix, some with "–" sign have to be explained:

- (C_C1.3, C_C2.1): (-2) – Increased use of information and communication technologies (ICT) in ports enables better relationships with both internal and external port stakeholders, which should in no way reduce the scope of the conventional general cargo transhipment. This phenomenon may rather intensify container transport, but not sure limiting the transfer of conventional general cargo. This is the reason why this coefficient has a negative sign in the reward matrix of the game, i.e. (-2);
- (C_C1.6, C_C2.2): (-3) – High quality implementation of environmental standards, environmental compliance procedures and sustainable development of ports is not possible without adequate staff in the quantitative and qualitative terms of its meaning, which implies that the port development in this direction will provide certain benefits to the working force, i.e. employees in the port. This is expressed in terms of (-3) coefficients in the reward matrix;
- (C_C1.6, C_C2.3): (-5) – The legislative and regulatory role of the government in the domain of the port sustainable development is irreplaceable. So, in this game the role of the government is the winning one, and it is logically evaluated as negative coefficient, subjectively assigned by (-5), etc.

3.2 RESOLVING THE MATRIX GAME

Following the logic described in the previous subsection, the top managers in each of the examined ports (P1 - Bar; P2 - Durres; P3 - Constantza; P4 - Koper; P5 - Piraeus; P6 - Ploče; P7 - Rijeka; and, P8 - Thessaloniki) have offered their estimations of the reward matrices (*Table 9*).

The matrix models formed in the previously described manner are solved as LP (Linear Programming) problems. More explicitly, the optimal solutions of the reward matrices have been found by LINGO software, based on the principal code shown in *Table 8*.

Table 8 - LINGO code for the matrix game

```
MODEL:
1]SETS:
2]ROWS/1..6/:X;
3]COLS/1..3/;
4]MATRIX(ROWS,COLS):REW;
5]ENDSETS
6]@FOR(COLS(J):@SUM(ROWS(I):
REW(I,J)*X(I))>V;); 7]@SUM(ROWS(I):X(I))=1;
8]MAX=V;
9]@FREE(V);
10]DATA:
11]REW=3,3,4,
12]1,4,4,
13]-2,2,3,
14]4,-3,4,
15]1,-2,-5,
16]2,-3,-5;
17]ENDDATA
18]END
```

In lines 2] and 3] the rows and the columns of the reward matrix $REW(i,j)$ have been defined respectively. The reward matrix itself is defined in line 4]. For each column "j", line 6] creates the constraint

$$\sum_i REW(i,j)\cdot X(i,j) \geq V,$$

where $X(i,j)$ corresponds to the probability that the *players* will play (i,j) pair of strategies, and V is the value of the game that is to be optimized. In line 7] it is made certain that the sum of the row of the player's probabilities is 1ensured that the row player's probabilities sum to 1. Line 8] creates the objective function, while line 9] uses the @FREE statement to allow V to be negative. In lines 11] through 16], the

Table 9 - Reward matrices for the considered ports and the LP solutions

Port 1	S/E	S1	S2	S3	⟶	S/E	S1	S2	S3
	E1	4	4.5	4.5	d+ = 0	E1	4	4.5	4.5
	E2	3.5	4	4		E2	3.5	4	4
	E3	3.5	4	4		E3	3.5	4	4
	E4	3	3.5	3.5		E4	3	3.5	3.5
	E5	3	3.5	3.5		E5	3	3.5	3.5
	E6	3.5	4	4		E6	3.5	4	4
					Solution:	V = 4 P = (1,0,0,0,0,0) Q = (1,0,0)			

Port 2	S/E	S1	S2	S3	⟶	S/E	S1	S2	S3
	E1	-3	3.5	4	d+ = 3	E1	0	6.5	7
	E2	-2.5	3	3.5		E2	0.5	6	6.5
	E3	-2.5	3	3.5		E3	0.5	6	6.5
	E4	-2.5	3	4		E4	0.5	6	6.5
	E5	-3	3.5	4		E5	0	6.5	7
	E6	-3	3.5	4		E6	0	6.5	7
					Solution:	V = 0.5 P = (0,0,1,0,0,0) Q = (1,0,0)			

Port 3	S/E	S1	S2	S3	⟶	S/E	S1	S2	S3
	E1	4	5	4.5	d+ = 0	E1	4	5	4.5
	E2	4	5	4.5		E2	4	5	4.5
	E3	4	5	4.5		E3	4	5	4.5
	E4	3.5	4.5	4		E4	3.5	4.5	4
	E5	4	5	4.5		E5	4	5	4.5
	E6	4	5	4.5		E6	4	5	4.5
					Solution:	V = 4 P = (0,0,1,0,0,0) Q = (1,0,0)			

Port 4	S/E	S1	S2	S3	⟶	S/E	S1	S2	S3
	E1	4	-3	-3.5	d+ = 3.5	E1	7.5	0.5	0
	E2	3.5	-2.5	-3		E2	7	1	0.5
	E3	3.5	-2.5	-3		E3	7	1	0.5
	E4	-2.5	-1.5	-2		E4	1	1.5	1.5
	E5	3.5	-2.5	-3		E5	7	1	0.5
	E6	3.5	-2.5	-3		E6	7	1	0.5
					Solution:	V = 1.43 P = (0,0.071,0,0.929,0,0) Q = (0.143,0,0.857)			

reward matrix has been imputed into the model [40]. Owing to this code, the optimal value of the matrix game and the corresponding mixed strategies can be obtained.

The values Sum_C1 and Sum_C2 calculated as sum products of the optimal matrix games vectors and the appropriate weight coefficients are given in *Table 10*. The last column corresponds to the sum of Sum_C1 and Sum_C2 values.

Finally, according to the previously described calculus (i.e. referring to the last column in *Table 10*), the positions of the ports based on their developing policies in the near future are determined and shown in *Figure 3*.

In confronting the preferred functions, compared to those more difficult to suppress, a space is being opened for port marketing repositioning. Based on numerical indicators, as per *Figure 3*, the port of Piraeus

Table 9 - Reward matrices for the considered ports and the LP solutions (continued)

Port 5	S/E	S1	S2	S3	⟶	S/E	S1	S2	S3
	E1	4	4	4	d+ = 3	E1	7	7	7
	E2	4	4	4		E2	7	7	7
	E3	4	4	4		E3	7	7	7
	E4	-3	-3	-3		E4	0	0	0
	E5	4	4	4		E5	7	7	7
	E6	4	4	4		E6	7	7	7
					Solution:	V = 7 P = (0,0,1,0,0,0) Q = (0,0,1)			
Port 6	**S/E**	**S1**	**S2**	**S3**	⟶	**S/E**	**S1**	**S2**	**S3**
	E1	3.5	3.5	3.5	d+ = 0	E1	3.5	3.5	3.5
	E2	4	4	4		E2	4	4	4
	E3	4	4	4		E3	4	4	4
	E4	4	4	4		E4	4	4	4
	E5	4	4	4		E5	4	4	4
	E6	4	4	4		E6	4	4	4
					Solution:	V = 4 P = (0,1,0,0,0,0) Q = (0,0,1)			
Port 7	**S/E**	**S1**	**S2**	**S3**	⟶	**S/E**	**S1**	**S2**	**S3**
	E1	-3	-3	4	d+ = 3.5	E1	0.5	0.5	7.5
	E2	-3	-3	4		E2	0.5	0.5	7.5
	E3	-3	-3	4		E3	0.5	0.5	7.5
	E4	-3.5	-3.5	4.5		E4	0	0	8
	E5	-2.5	-2.5	3.5		E5	1	1	7
	E6	-2.5	-2.5	3.5		E6	1	1	7
					Solution:	V = 1 P = (0,0,0,0,1,0) Q = (0,1,0)			
Port 8	**S/E**	**S1**	**S2**	**S3**	⟶	**S/E**	**S1**	**S2**	**S3**
	E1	-3.5	5	4	d+ = 3.5	E1	0	8.5	7.5
	E2	-2.5	4	3		E2	1	7.5	6.5
	E3	-3	4.5	3.5		E3	0.5	8	7
	E4	-3.5	5	4		E4	0	8.5	7.5
	E5	-2.5	4	3		E5	1	7.5	6.5
	E6	-3.5	5	4		E6	0	8.5	7.5
					Solution:	V = 1 P = (0,1,0,0,0,0) Q = (1,0,0)			

has the largest space for port repositioning. Namely, the dominant strategy upon which it is necessary to put more efforts in advanced automatization of port processes and reduction of government participation in port management should be the optimal solution for the Piraeus port development. Furthermore, this strategy is also optimal in the case of the Ploce port, which, having in mind the previous positioning (and in terms of quantitative and qualitative criteria), achieved an under-average position, and now gets a great *opportunity* for as good repositioning as possible.

The ports of Bar and Durres have equal *opportunities* for better repositioning, but naturally, their strategies are different. The Port of Bar management faces the challenge of an intensified container transhipment compared to the general cargo handling. According to this model, the port of Durres should intensify the implementation of ICT technologies at terminals, while,

Table 10 - The matrix game solutions pondered by the weight coefficients

Criteria/ Port	C1.1	C1.2	C1.3	C1.4	C1.5	C1.6	C2.1	C2.2	C2.3	Sum_C1	Sum_C2	Total
P1	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	4.50	2.88	7.38
P2	1.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	4.50	2.88	7.38
P3	0.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	4.13	2.88	7.00
P4	0.00	0.07	0.00	0.93	0.00	0.00	0.14	0.00	0.86	3.53	3.52	7.04
P5	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	4.00	3.63	7.63
P6	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	3.88	3.63	7.50
P7	0.00	0.00	0.00	0.00	1.00	0.00	0.00	1.00	0.00	3.75	3.50	7.25
P8	0.00	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	3.88	2.88	6.75
Avg.	4.50	3.88	4.00	3.50	3.75	4.13	2.88	3.50	3.63			

on the other hand, it would be optimal to expect the reduction in the scope of handling general, conventionally packaged cargo.

The port of Rijeka, having in mind its position above the average in terms of positioning based on qualitative criteria (see *Figure 2*), as the repositioning strategy has an option of improving the prevention of risky situations in the port, but also the reduction in the number of employees, in accordance with the current situation at this port.

The port of Koper is the only one of those analyzed in which the resolution of the matrix game is not in the domain of the so-called pure strategies, but in the domain of the mixed ones. Thus, its positioning comprises activities in four directions. The automation of the processes needs to be developed, followed by the range of port services being expanded as the only segment of the total marketing activities of this port. On the other hand, it is recommended to intensify the reduction of government participation in port operations, as well as the reduction in the scope of general cargo handling.

Considering the port of Constantza, its development should follow the direction of the dominant increase in the ICT solution implementation, parallel with the dominant reduction in general cargo handling. In the port of Thessaloniki, general recommendation in terms of optimal development is based on the dominant reduction in the scope of general cargo handling.

In this context, we should make several remarks related to the weight coefficient values. Namely, the respondents have estimated averagely the importance of the development function of port operations. The respondents decided that the highest importance be awarded to the reduction in the government participation in port management, followed by the reduction in the number of employees, and, finally, the reduction of the general cargo participation in the overall transhipment structure.

It should be emphasized here, that weight coefficients, as well as the reward matrices, have been subjectively estimated by the top managers in the ports

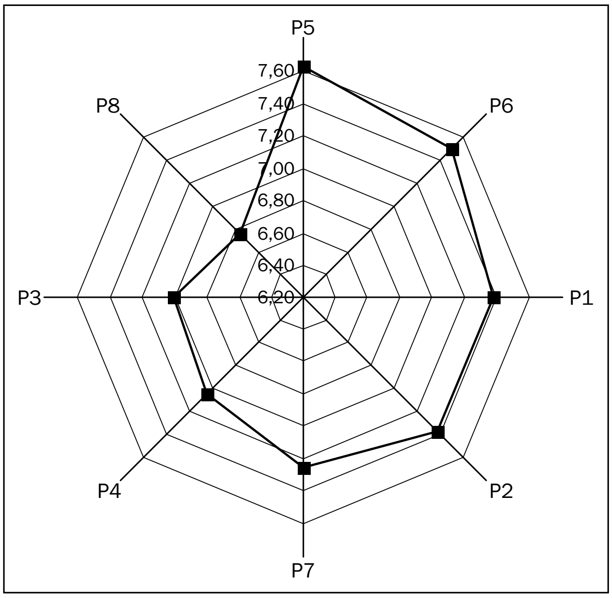

Figure 3 - The ports positions estimated by the matrix game approach

that are subject of this research, though the obtained results might be different in the case(s) in which some other managers or administrative staff members in the ports have been asked for their opinions.

4. CONCLUSION

The paper analyzes the Adriatic, Aegean and Black Sea ports, based on quantitative, qualitative and development criteria. The quantitative and qualitative criteria, maintaining the existing situations in the analyzed ports, have been applied through a detailed development of benchmarking concepts. The development criteria, reflecting some kind of future condition of the analyzed port systems, have been treated upon the concept of matrix game. The ports have been mutually positioned within the frame of applied benchmarking method, and their positions have been determined in relation to the imaginary leading and average port. The positioning strategy does not end with the existing presentation of the situation; it initiates *opening* of space for finding new, original ways for seaport repositioning. Therefore, in the context of applying the concept of matrix game, each port is determined by an optimum space and directions for its marketing repositioning.

The contribution of the paper is that it offers a comprehensive model combining the principles of strategic marketing, mathematical calculations anticipating benchmarking methods, thus well-known, structural and frequently applied concept of the matrix game. The general goal is to turn from internal business parameters of the eight researched ports towards the market ones. Naturally, internal performances were necessary in order to offer the respondents, primarily customers, the ranking scale for the criteria (quantitative, qualitative and development ones) being mostly preferred. In this way, the opinions of the customers, combined with the fixed values of port capacity parameters, are descriptively presented on the perception maps. It is important to point out that ports are differently positioned in case of analyzing quantitative, qualitative and development criteria. The positioning of the ports based on the development criteria, to some extent, confirms the quality of the positioning in the previous two cases. Namely, if a port has a worse position based on the analyses of the quantitative and qualitative criteria, this would, in case of positioning upon development criteria, imply the creation of a wider space for its repositioning, which has been proven through the obtained results in the paper.

As possible directions of future research work in this field the following four issues are proposed:

a) employing alternative methods in order to reduce the impact of subjectivity in assessing the importance of the analyzed quantitative and qualitative criteria;
b) providing more extensive and accurate database of numerical data, especially on the qualitative performances of ports, as well as more sensitive assessment of the respondents with high degree of logical thinking and expert knowledge;
c) taking into consideration the new criteria as the pillars of positioning, based on the dimensions of quality of port services, such as transit time, berth productivity, cost savings, including other factors that represent the efficiency of cargo handling and all operational processes in the ports; and
d) upgrading the research approach from the port level toward a complex one: maritime transport - ports - inland transport level, i.e. creating and implementing positioning strategy at the maritime logistics chains level.

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REZIME

KOMBINOVANJE KONCEPATA BENČMARKINGA I MATRIČNE IGRE U MARKETINŠKOM (RE) POZICIONIRANJU POMORSKIH LUKA

U ovom radu se razmatraju efekti kombinovanja dva različita pristupa u razvoju strategije pozicioniranja pomorskih luka. Prvi pristup se temelji na upoređivanju najvažnijih kvantitativnih i kvalitativnih kriterijuma za izbor pomorskih luka putem benčmarking metode. Benčmarking je korišćen u kreiranju odgovarajućeg modela za efikasno marketing pozicioniranje luka egejskog, jadranskog i crnomorskog sliva. Kriterijumi koji opisuju stepen konkurentnosti ovih pomorskih luka su izabrani na osnovu istraživanja preferencija korisnika. Drugi pristup je baziran na konceptu matričnih igara i korišćen je u svrhe optimalnog repozicioniranja luka. Naime, ovdje je devet izabranih lučkih funkcija tretirano na način da su podijeljene u dva skupa: jedan, formiran od funkcija koje će se razvijati, i drugi, sačinjen od funkcija za koje se očekuje da će biti supresirane u perspektivi. Shodno dobijenim numeričkim rezultatima analizirane luke su repozicionirane, pri čemu su data odgovarajuća marketinška tumačenja. Kombinovanje ova dva koncepta trebalo bi da doprinese dobijanju jasnog uvida u postojeće stanje ovih poslovnih sistema i njihov imidž na tržištu, te da otvori perspektive u pogledu pronalaženja načina za kreiranje i održavanje konkurentske prednosti.

KLJUČNE RIJEČI

marketing pomorskih luka, strategija pozicioniranja, benčmarking, matrična igra, percepciona mapa

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